

Chemical & Radiation Exposure

DONE BY / DOVISH



HAZARDOUS MATERIAL (*hazmat*):

- ▶ Is defined as any substance, including gases, solids, or liquids, that has the potential to cause harm to people or the environment .

MECHANISM INVOLVED IN INJURIES:

- Direct Chemical reaction. - Hyperthermic (exothermic reaction)

THE DETERMINATION OF THE DEGREE OF INJURY :

- **Concentration** (e.g. It differs when you swim in a pool mixed with chemical compound, or when someone throw fresh chemical compound directly on you body)
- **Duration of exposure.**
- **Anatomically weaker body parts (areas of thin skin).** *Skin that is particularly thin or broken can contribute to more severe injury.*

THE DIFFERENCES BETWEEN ACIDIC & ALKALIC INJURIES :

- **Acids:** Cause protein denaturation & coagulative necrosis, and then Escharformation.
- **Alkali:** Saponification and liquefactive necrosis of body fat.

ALKALI IS MORE DANGEROUS

COPING WITH HAZMAT INCIDENTS:

- Securing Scene, implementation of site plan & evacuation.
- Treatment which starts with **decontamination.**

GENERAL MANAGEMENT PRINCIPALS: -Remove from hostile environment. -Remove cloths.

- Decontaminate (wounds, then eyes, then mucus membranes, then skin, then hair).

Goal is to normalize skin PH. -Hydrotherapy. (Treatment with water)

HYDROFLORIC ACID

- Acidic aqueous solution.
- Used in the petroleum industry, Removing rust, and cleaning cement and bricks.
- Absorption from lungs, skin, and eyes.
- Liquefactive necrosis, similar to alkalis.
- Free fluoride ion is responsible for the injury.
- **Hypo Calcaemia, Hypo Magnesia, Hyper Kalemia, Qt prolongation ,Hypotenstion, Arrethmias.**

ROUTES OF EXPOSURE :

- Dermal (**most common**) : **Eschar**, whitish appearance with vesicle.
- Occular : Severe burn with penetration and necrosis of the structures throughout the **anterior chamber** , **Irrigation** is the key .
- Gastro (Rare) : Lethal
- Respiratory : Inhalation and skin exposure to 70% HF can result : **Pulmonary edema & Death within 2 hours .**

MANAGEMENT: 1-Irrigation for 15 to 30 minutes.after that Blister removal.

2 - Detoxification Locally andl infusion of **Ca. Gluconate.**



HYDROCARBONS

Found in fuels, solvents, paints, paint and spot removers, dry cleaning solutions, lamp oil, rubber cement, and lubricants.

Classified to :

- Aromatic : Ring shaped carbon .
- Aliphatic : Linear Branched shaped carbon .



MECHANISM OF ACTION :

- Lungs (aspirations) are the **most common** organ affected .
- Systemic toxicity from dermal exposure is rare.
- Ingestion of hydrocarbons can result in aspiration and systemic toxicity
- Perioral or perinasal dermatitis with pyoderma. This so-called “huffer’s rash” (pic)
- **Substances with high volatility, low viscosity, and low surface tension are the most toxic.**

MANAGEMENT :

- Remove offending agent and Irrigation.
- Airway management (**most important**).
- Bronchodilators and Observation for minimum of **6 h after ingestion**

CHEMICAL TERRORISM

- (1) Nerve agents.
- (2) Vesicants (Blistering agents). : (Mustard agents)
- (3) Choking agents. : (Chlorine)
- (4) Cyanide and related toxins.

NERVE AGENTS :

- The primary mechanism of action of the nerve agents to prevent acetylcholinesterase from hydrolyzing Ach (Muscarinic effect).
- Effects of Muscarinic Receptors:
 - **DUMBELS** (diarrhea, urination, miosis, bronchoconstriction or bronchorrhea, emesis, lacrimation, and salivation).
 - **SLUDGE** (salivation, lacrimation, urination, defecation, and gastrointestinal emesis).
- Effects of Nicotinic Receptors: - Muscle fasciculation and weakness.
- Primary clinical toxic effects are **respiratory**.

MANAGEMENT :

- irrigation with water & maintain ABC emergency.
- Anti-muscarinic (**Atropine**), pralidoxime. (the muscarinic Antidote is Atropine. However, you have to Add MORE and MORE Atropine)
- Benzodiazepines for seizures.

Cont... (Cyanide)

Cyanide salts and hydrocyanic acid are commonly used for metal cleaning, metal extraction, photographic processes .

precious

MECHANISM OF ACTION: Cellular toxin → Binds to both Fe³⁺ and cobalt. → Inhibits oxidative phosphorylation. → Cellular hypoxia and death.

CLINICAL FEATURES :

- Sudden cardiovascular collapse.
- Profound metabolic acidosis. (Lab tests : **lactic acid** increased more than 10 and **Hypoxia**).
- A characteristic odor of bitter almonds is frequently discussed but only rarely clinically noted.

MANAGEMENT :

- Decontamination
- ABCD
- Antiarrhythmics
- Antidotes (there are two types of Cyanide antidotes):
 1. **Cyanide antidote kit** (Amyl nitrite, sodium nitrite, and sodium thiosulfate)
 - **Amyl nitrite and Sodium nitrite**: induces methemoglobinemia cyanide → binds to methoglobin forming Cyanomethoglobin (Nontoxic)
 - **Sodium thiosulfate**: enhances transulfuration of hydrogen cyanide to thiocyanate (Nontoxic) , which is renal excreted
 2. **Hydroxocobalamin** for treatment of cyanide intoxication, which branded as Cyanokit antidote

RADIATION EXPOSURE

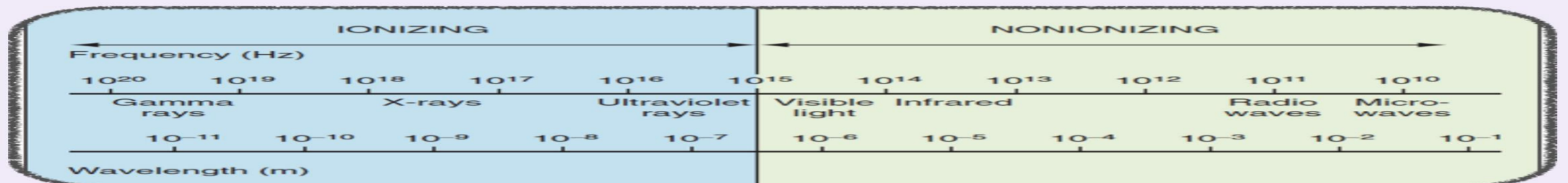
- **Radioactivity:** refers to the loss of particles (e.g., alpha, beta, or neutrons) or energy (e.g., x-rays and gamma rays) from an unstable atom that is spontaneously decaying.
- **Decay:** The spontaneous transformation of an unstable isotope to a stable one, and it may involve the release of ionizing radiation.

Nonionizing radiation

- The primary adverse effects of nonionizing radiation are related to **local heat production**.

Ionizing radiation

- Directly cause **cell death** or **damages the DNA**
- Ionizing radiation is emitted in the form of **alpha and beta particles, gamma rays, and x-rays**.



- **Irradiation:** (is the process by which an object is exposed to radiation) Object that is irradiated does not become radioactive Contamination
- **Radioactive contamination:** is a radioactive particulate matter (alpha and beta particles) on an exposed surface This radioactive particulate matter may emit radiation with an effect that is directly related to the time of exposure, distance from the source, and type of contamination. Incorporation
- **Incorporation:** occurs when a radioactive material is ingested, inhaled, or absorbed through an open wound

ACUTE RADIATION SYNDROM

Is a symptom complex that occurs after whole-body irradiation. It varies in nature and severity by dose, dose rate, dose distribution, and individual susceptibility.

- The early indicator for a significant radiation exposure **is the absolute decreased lymphocyte count**, which can occur within 48 hours after exposure table 1
- The LD50 or median lethal whole-body dose (the dose that is lethal for 50% of test population), assuming proper medical care, is estimated to be **approximately 4.5 Gy (Gray)**

MANAGEMENT : (Sever injury and poor prognosis = Lymphocyte count less than **500**)

- Reduce Exposure.(time, distance, and shielding)
- Decontamination
- Effective (Emergency Department) preparedness (Involve radiation control officer).
- Geiger-Mueller instrument for monitoring the environment. Pic
- ABCD's & Supportive measures.
- Chelating agents for Internal contamination. Table2

MINIMAL LYMPHOCYTE COUNT (per mm ²)	APPROXIMATE ABSORBED DOSE (Gy)	EXTENT OF INJURY	PROGNOSIS
1400-3000 (normal range)	0-0.4	No clinically significant injury	Excellent
1000-1499	0.5-1.9	Clinically significant but probably nonlethal	Good
500-999	2-3.9	Severe	Fair
100-499	4-7.9	Very severe	Poor
100	8	Most severe	High incidence of death even with hematopoietic stimulation

MEDICATION	RADIOACTIVE ISOTOPE
Ferric hexacyanoferrate (Prussian blue)	Cesium-137, thallium
Ca- and Zn-diethylenetriaminepentaacetate (DTPA)	Plutonium, americium, curium
Potassium iodide	Radioiodine
Penicillamine	Radioactive heavy metal poisoning (lead)

▶ IMPORTANT NOTES FOR CONTAMINATION AND EXPOSURE .

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Contamination and Exposure

- Contamination takes place when contact is made with radioactive material and it is deposited on the skin, clothing, surfaces, etc.
- Exposure to radiation occurs when a person or an object is close enough to radioactive material to be affected by it without touching it.



WORKER EDUCATION & TRAINING PROGRAM

- ▶ If a person passed by radiation **without** touching or inhaling it --> exposure.
- ▶ If a person has a contact with the radiation --> external contamination
- ▶ If a person inhaled the radiation --> internal contamination
- ▶ If an exposed person passed by me --> I will not get affected
- ▶ If a contaminated person passed by me --> I'm exposed